Dissipation in Nonlinear Shallow Water Random Waves

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The development of accurate wave dissipation mechanisms in spectral wave models has been an active area of research in recent years, particularly as nonlinear wave models have become tenable as diagnostic tools. Interestingly, however, Kaihatu (2001), showed that the higher order moments (skewness and asymmetry) were not optimally predicted with a nonlinear wave model, despite clear physical arguments to the contrary. This led to conjecture that the basic lumped parameter model at the heart of the dissipation mechanism is inadequate.

In this study we begin with the vorticity-based breaking model of Veeramony and Svendsen (2000), which inherently contains the effect of the wave roller. We transform this model into the frequency domain and seek to localize the effect of breaking by switching out of the frequency domain and calculating the dissipation characteristics when the breaking criterion is met. We also develop, and include, a two-dimensional extension of an inverse-FFT nonlinear formulation. This formulation uses the time domain to calculate the nonlinear terms, a substantial computational savings. The inverse-FFT form also uses the frequency domain to evaluate spatial and temporal derivatives of the nonlinear terms in the time domain Boussinesq equations. We can therefore investigate the efficacy of retaining arbitrarily-high order nonlinearity, since the requirement of weak nonlinearity to effect a frequency domain transformation of the time domain equations is now removed.